Chapter 7

PARATRANSIT AND RIDESHARING

DAVID W. JONES, JR., AND CLIFFORD A. CHAMBERS

Travel in privately owned vehicles accounts for the lion's share of trip making in metropolitan America—81.3% of all local trips.1 Walking accounts for another 8.8% of local trip making, while public transportation accounts for only 2.9%. These are nationwide aggregate statistics, but they demonstrate that it is the automobile, van, and pickup truck that provide mass transportation for urban America.

Such data are a striking reminder that the United States is overwhelmingly dependent on the automobile for urban mobility. But examined more closely, the same travel data reveal how frequently Americans put private transportation to collective use through ridesharing. Passengers riding in cars, vans, and trucks account for almost 32% of the mileage traveled in metropolitan America.2 In other words, the collective use of private vehicles provides Americans with a source of mass mobility that other nations have sought from public transportation.

"Going together" is an apt description of most ridesharing: informal and unorganized—a husband and wife driving together, teenagers on a date, friends going shopping together. In a motorized society, going together by car is not perceived as ridesharing, much less carpooling. But no matter how informal such arrangements may be, ridesharing makes an enormous contribution to urban mobility. This is shown in Table 7-1, which provides an aggregate, nationwide profile of metropolitan trip making.

While informal ridesharing has been with us since the earliest days of motoring, organized ridesharing is a more recent phenomenon. Carpooling was first promoted during World War II as a petroleum and rubber conservation measure and was promoted again during the energy crisis of the 1990s and 1980s. Carpooling has also been advanced as a strategy for reducing automotive pollution and managing traffic congestion.

TABLE 7-1

Aggregate Profile of Trip Making in Metropolitan America

Mode of Trip Making	Share of All Trips	Share of Home-to-Work Trips
By auto and van drivers	54.3%	74.5%
By auto and van passengers	27.0%	11.7%
By public transportation	2.9%	6.2%
By walking, motorcycle, bicycle, other means		15.8%7.6%

Source: Adapted from Dieter Klinger and J. Richard Kuzmyak, *Personal Travel in the United States; Vol. I and II, Nationwide Personal Transportation Study,* prepared by COMSIS Corporation for FHWA (Washington, D.C.: U.S. Department of Transportation, August 1986).

Paratransit consists of public and semipublic transportation services that are more flexible and personalized than conventional fixed-route, fixed-schedule service. It utilizes low- and medium-capacity highway vehicles. Public paratransit is available to anyone who pays a predetermined fare (for example, taxis, jitneys, and dial-a-ride). Semipublic paratransit is available only to people of a certain group, such as the elderly, employees of a company, or residents of a neighborhood (as in, vanpools and subscription buses).

Some forms of paratransit and ridesharing have been advanced as a response to the special transportation needs of the elderly and handicapped. Still other forms have been introduced in suburban and rural communities where travel patterns are inimical to the efficient operation of conventional transit service. Recent efforts to organize and facilitate paratransit and ridesharing entail three distinguishable thrusts: (1) efforts to promote carpooling, vanpooling, and club-bus arrangements to serve commute trips; (2) efforts to field transit-like services with the routing and scheduling flexibility necessary to serve small towns and outlying suburbs; and (3) efforts to provide specialized transportation services for the elderly and handicapped. Table 7-2 profiles the three primary methods and markets of these types of transportation. It must be emphasized that each type has its own history, its own political constituency, and its own niche in the transportation marketplace.

What these services have in common is the use of freewheeling vehicles in combination with organizational effort to provide what might be called personalized transit services. The result is a family of services that lies intermediate between personal and mass transportation. We have coined the phrase "plural transportation" to describe these travel arrangements. *By plural transportation* we mean a diverse set of market-specialized

transportation services and organized travel arrangements that make collective use of private transportation. We have coined this terminology and will use it in the pages that follow because prevailing nomenclature does not communicate the diversity of ways that freewheeling transportation can be organized for shared or collective use.

TABLE 7-2
Three Primary Types of Paratransit and Ridesharing

	Basic Service Concept	Typical Methods	Primary Market	Key Policy Objectives
On-demand transportation services	Service is provided on telephone request; vehicle tours are determined by trips to be served.	• Dial-a-ride • Shared-ride taxi ° Route deviation bus service	General travel in small cities and low-density suburbs.	Basic transit services for transit dependent.
Commuter ridesharing	A third party recruits potential riders and matches them with prospective drivers or commercial providers.	° Organized car-pooling ° Vanpooling ° Club or subscription bus service	Commute trips longer than 15 miles for car-pools; over 25 miles for vanpools and buspools.	Congestion management. Improved air quality. Episodic energy conservation.
Client Transportation for special need groups	Client transportation is arranged, sponsored, provided, or subsidized by a social service agency or public paratransit program.	° Volunteer drivers ° Social service agency provides ° Private operator provides	The elderly and handicapped.	Basic mobility for disadvantaged.

Figure 7-1 begins to illuminate this diversity by showing common arrangements for commuting and for getting to the doctor's. As the figure illustrates, plural transportation is a diverse set of travel arrangements that enable urban residents to ride together in pairs, threes, groups, or series. As it also shows, plural transportation is *organized* transportation that lies intermediate between personal use of the private car and mass public transportation. This is its significance: Efficiently organized plural transportation can retain much of the flexibility of personal transportation, while offering most of the price advantage of mass transportation.

THE CHARACTERISTICS OF PLURAL TRANSPORTATION

Organization is the hallmark of plural transportation. By organization we mean some arrangement for aggregating demand, sharing costs, and then providing transportation. Such arrangements can range from simple understandings between friends to elaborate arrangements that involve multiple parties and complex financial agreements. Five examples will illustrate the range of possible arrangements.3

• John X asks friend and co-worker Frank Y if he would like to share a ride to work. Frank agrees to pay for gas, and John drives.

° The XYZ Corporation administers an aggressive ridesharing program designed to allay community concern about traffic congestion near the suburban office park where the company is headquartered. Employees who carpool are guaranteed close- in parking and reserved spaces. A registry of carpools is maintained with cross-filing by employee home zip codes. The carpool registry

allows the company's commute coordinator to keep track of empty seats in some 200 carpools. New employees are urged to join established carpools when they sign on with the company

° Regional Rideshare operates a vanpooling program that screens and qualifies van drivers, recruits vanpool riders, and brokers lease agreements for 12 to 15 passenger vans. It recruits riders through direct advertising and a workplace outreach program. Potential riders are paired together on computer match lists, with personalized attention to geographic clusters large enough to form a vanpool. After a driver is recruited and a van is placed in service, it continues to recruit riders to fill empty seats. Regional Rideshare is a nonprofit organization; its operations are financed by a highway department.5

° The city of New Z manages a program that enables senior citizens to obtain text service at below-market rates. The program is built around a state subsidy for paratransit and a formal agreement with the city's taxicab operators. Taxi operators have agreed to accept redeemable script from senior citizens in lieu of cash payment. Seniors purchase the script from the city at 50% of its face value. It is redeemed at full value, with state funds used to make up the difference. At the outset of the program, taxi operators agreed to roll back fares because additional ridership by seniors allows the companies to do a brisk business during otherwise slack periods of the day.6

° The state highway department has built an additional freeway lane in a congested urban corridor. This high-occupancy vehicle (HOV) lane is reserved for exclusive use by buses, carpools, and vanpools. The HOV lane enables buses and carpools to bypass congestion and provides an incentive for ridesharing. The installation of park-and-ride facilities in the same corridor provides a convenient place for carpool

riders and drivers to meet. Additional use of the HOV lane is encouraged by means of an aggressive ride-matching program that provides transit information and carpool matching assistance to commuters at their place of work. The ride-matching program is sponsored by a consortium of private employers and public agencies called a transportation management association (TMA). The board of directors of the TMA includes representatives of local business, local government, the transit agency, and the state highway department.7

As these examples suggest, the essential characteristic of plural transportation is some arrangement for aggregating demand so as to exploit the economies of scale latent in the joint use of freewheeling transportation. The most common form of joint use is ridesharing—multiple riders using the same vehicle at the same time. But joint use can also be accomplished by organizing and scheduling trips in productive series. As the taxicab example suggests, *serial* use can produce economies similar to those realized through *shared* use. Dial-a-ride systems, it should be noted, embody both forms of joint use—shared and serial.

THE RECENT HISTORY OF PLURAL TRANSPORTATION

The recent history of plural transportation evidences two countervailing dynamics. The first of these dynamics is social and demographic: on a percentage basis, fewer Americans are ridesharing this generation than last.8 The second dynamic is policy driven—the effort of governmental agencies to promote ridesharing and provide special transportation services. These are countervailing dynamics, but the first is far more powerful than the second. Governmental efforts to encourage carpooling and other forms of plural transportation have been nowhere near sufficient to offset social and demographic trends that are eroding the contribution that informal ridesharing once made to urban mobility. In other words, the effort to promote and institutionalize ridesharing and paratransit is losing ground due to the changing travel patterns and demography of metropolitan America. In this sense, plural transportation is much like public transportation: its market share is declining in the face of social and geographic changes that have reduced the percentage of trips for which any form of collective transportation offers a compelling alternative.

Table 7-3, based on nationwide aggregate data, shows three ways of quantifying plural transportation's shrinking presence in the transportation marketplace. As it shows, average vehicle occupancy is declining, as are the share of trips and VMT logged as riders rather than drivers.

TABLE 7-3
Aggregate Trend of Metropolitan Travel

Year	Work-Trip Vehicle Occupancy (persons per vehicle)	Share of Work Trips by Riders Not Drivers	Share of Work-Related VMT by Multi Occupancy Vehicles
1969	1.4	—	—
1977	1.3	17.3%	21.2%
1983	1.2	11.7%	19.2%

Source: Adapted from Dieter Klinger and J. Richard Kuzmyak, *Personal Travel in the United States; Vol. I and II, Nationwide Personal Transportation Study*, prepared by COMSIS Corporation for FHWA (Washington, D.C.: U.S. Department of Transportation, August 1986).

The principal dynamics underlying these trends are geographic and demographic:

° Differential growth rates that have diminished the share of the nation's population that lives in the older and denser cities of the Northeast.9

° The rapid growth of sunbelt employment and sunbelt cities with auto-oriented travel and settlement patterns.

° The rapid growth of suburban population and employment, and the increasing prevalence of intra- and intersuburban commuting.10

• The increasing prevalence of intrasuburban commutes that end at a workplace that provides free parking.

• Sharp increases in the rate of women's labor force participation, and corresponding increases in the proportion of two-income, two-car households.11

• The coming of age of a generation of senior citizens that is accustomed to driving and expects to do so well into retirement 12

Table 7-4 profiles some of the outcomes associated with these trends. As the table suggests, changes in the geography and demography of employment have had significant impacts in the aggregate—on auto ownership,

on urban population density, and on the share of trips for which plural and public transportation offers a compelling alternative.

TABLE 74

Evidence of America's Increasing Reliance on the Automobile and Individual Transportation

Year	Suburban Share of the Nation's Metropolitan Population	Average Number of Vehicles per Household	Average Vehicle Occupancy for Trips to Work
1950	42%	_	_
1969	54%	1.2	1.4
1977	_	1.6	1.3
1983	58%	1.7	1.2

Source: Adapted from Dieter Klinger and J. Richard Kuzmyak, *Personal Travel in the United States; Vol. I and II, Nationwide Personal Transportation Study,* prepared by COMSIS Corporation for F~WA (Washington, D.C.: U.S. Department of Transportation, August 1986) and U.S. Department of Commerce, U.S. Bureau of the Census, *State and Metropolitan Area Book* (Washington, D.C.: U.S. Government Printing Office, 1989).

The secular erosion of plural transportation would not matter much if policy makers were not relying on it to achieve congestion relief, pollution control, and the mobility of the elderly and the handicapped. But policy makers are relying on the *expansion* of plural transportation, while metropolitan development trends are *diminishing* its presence in the transportation marketplace.13 In other words, these are trends with significant policy implications. They explain why the nation has made no progress in diminishing its dependence on imported oil; why improvements in metropolitan air quality have proved so hard to achieve; why suburban congestion has become, almost overnight, a salient political concern; and why both plural and mass transportation systems have continued to surrender market share despite government subsidy and promotion. These trends provide the backdrop against which to understand and evaluate governmental efforts to promote ridesharing and other forms of plural transportation.

GOVERNMENTAL EFFORTS TO PROMOTE PLURAL TRANSPORTATION

Although *informal* ridesharing arrangements have been eroded by social and geographic change, *formal* and *organized* ridesharing has been encouraged by governmental promotion. Government funding and regulation have both played an important role in the development of commuter ridesharing programs, demand-responsive transit service, and paratransit services for the elderly and handicapped. Federal funding played an important role in the initial development and diffusion of these services; state and local funding and local regulations have made the difference between programs that are vigorous and programs that are not.

The development of dial-a-ride and other forms of demand-responsive transit service is most advanced in Michigan and California, where state funding is earmarked for such services.14 Paratransit development is also well advanced in California counties that have reserved sales tax funds for creating user-side subsidy programs and modifying taxi ordinances to enable shared-ride operation.15

The creation of regional ridesharing agencies was financed by the federal government, and federal funds play an important role in sustaining these operations. But ridesharing promotion efforts are most vigorous in communities where local governments have used their regulatory powers to engage employers in ride matching. In turn, regional air quality districts have required employers to meet more strenuous standards designed to reduce automotive pollution.

As these examples suggest, the institutionalization of plural transportation is reasonably well advanced. Service concepts developed in the 1960s and demonstrated in the 1970s have taken local root in the 1980s.16 The organization, regulation, and funding necessary to support and sustain ridesharing and paratransit services remain fragile and limited, but permanent institutional commitments have been made.

With permanent commitments has come a burden of social expectations, as relatively small programs were asked to achieve large social purposes. Dial-a-ride systems were touted as an opportunity for transit to capture urban market shares in suburban communities.17 Ridesharing programs were advertised for their contribution to energy conservation and air quality.18 Paratransit was asked to compensate for the mobility disadvantage of the carless elderly and handicapped. And, most recently, commuter ridesharing has been advanced as a cornerstone of suburban plans for congestion management.19 In the pages that follow, we will examine how well plural transportation has acquitted itself in the face of these lofty policy expectations.

COMMUTER RIDESHARING AND CONGESTION MANAGEMENT

The events of the 1960s and 1970s produced a profound change in the premises with which urban planners approached metropolitan transportation. This change was shaped by the conflict and controversy over the urban routes of the Interstate Highway

System, the energy crisis, the growth of environmentalism, increasing awareness of the health effects of air pollution, and growing awareness of the costs of sprawl. Transportation planners emerged from the 1960s and 1970s doubting the efficacy of plans premised on the unconstrained growth of automobile traffic and the endless attenuation of metropolitan boundaries. As an alternative, they proposed a planning strategy with two complementary elements: *urban containment* and *traffic management.20* This new metropolitan strategy was designed to constrain the sprawling growth of outlying suburbs and to provide incentive for commuters to use collective transportation.

This new strategy has been widely endorsed but only partially implemented. Traffic management has been widely accepted as the appropriate strategy of transportation planning, but metropolitan planners have had virtually no success in obtaining decisive commitments to constrain and redirect suburban growth. In other words, a policy commitment has been made to traffic management, but not to urban containment.

The policy commitment to traffic management is the context in which commuter ridesharing and other strategies to increase vehicle occupancy have been vested with significant social expectations.21 In turn, the 1970s and 1980s witnessed increasing linkage between ridesharing programs and congestion management. As a result, ridesharing agencies that were first established as a response to the 1973 oil embargo and the energy crisis were reemployed as agents of congestion management.

The linkage between ridesharing and congestion management created a flurry of organizational effort to engage employers in ride brokering, to create multicity ridesharing programs, and to coordinate ridesharing campaigns with the development of HOV lanes and park-and-ride facilities. Thus, the 1980s saw the creation of the organizational infrastructure necessary to harness ridesharing as a strategy of congestion management. These institutional arrangements are shown in Fig. 7-2. As the figure shows, mandatory legal requirements that oblige employers and developers to participate in ride-brokering programs were a prominent feature of many plans developed in the 1980s and early 1990s. In the pages that follow, we will reprise the most important developments in commuter ridesharing.

EMPLOYER-BASED RIDE BROKERNG

Work-site ridesharing campaigns have a long history, but the creation of *permanent*employer-based ridesharing programs is a comparatively new phenomenon. Historically, employers have avoided commitments that would burden companies with the responsibility for employee transportation. The exception was wartime emergencies when commerce and industry played an active role in carpooling campaigns. But the developments of the 1970s and 1980s have engaged employers in ridesharing on a permanent basis. Initial engagement occurred with the energy crisis and has become virtually permanent for employers located in metropolitan areas where air quality and suburban congestion are a continuing problem.

The permanent involvement of employers in ride brokering is an important development for obvious reasons. Fellow employees share a common destination and are thus "presorted" prospects for ridesharing. The communication channels of the workplace provide an opportunity to recruit ridesharing candidates. New employees are prime candidates for ridesharing. Data routinely collected by personnel departments provide the information base necessary to plan and target ridesharing programs. Corporate staffing of ridesharing programs increases the effectiveness of regional ridesharing agencies. As important, company staffing—even part-time staffing—provides the personnel necessary to provide personalized ridesharing assistance. And the coordination of ridesharing programs with changes in parking policy can provide a proven incentive for carpool formation.

The involvement of many companies in ridesharing has been reluctant—an ambivalent commitment prodded by governmental request or regulation. But some companies have actively embraced ridesharing as an expression of a high-profile corporation's commitment to good citizenship and community service. For example, the 3M Company in Minneapolis, Minnesota, launched the nation's first vanpool program in 1973. The program was motivated by conventional business logic: vanpooling offered a way for the company to expand its headquarters staff without devoting precious land to additional parking space. The program was a phenomenal success, and 3M built good will by assisting other corporations in developing their own vanpooling programs. Indeed, a list of the corporations most active in ridesharing reads like the Dow Jones Industrials—ARCO, ATT, Conoco, Hewlett-Packard, Lockheed, the Travelers, and State Farm, to name a few.

The cornerstone of employer-based ridesharing efforts is transportation brokerage—a concept borrowed from the trucking industry. A workplace broker or transportation coordinator finds the best commute alternative for individual employees—supplying the managerial effort needed to organize carpools or vanpools, arrange charter bus service, procure shuttle bus services, or sell transit passes. Employer-based transportation brokerage has historically been market oriented, matching employee needs with a full mix of commute options. It should be noted that most brokerage efforts have been small scale, with time commitment ranging from a few hours a week to a full-time position for the largest firms. In a recent study of 252 Los Angeles firms, it was found that the average firm spent 0.31 h and $5.07 per employee per year on employee ridesharing programs.22

Even part-time staffing permits the personalization of ridesharing programs. The key to the personalized approach is the one-to-one interaction between a trained transportation coordinator and a prospective ridesharer.

Instead of relying solely on an impersonal lobby locator list or a computer printout, the employer coordinator makes the introductions necessary for ridesharing candidates to feel comfortable about joining a carpool or vanpool, or at least committing to trial membership. The theory of personalized assistance was bolstered by a major survey of carpooling behavior conducted by Margolin and Misch.23 These researchers found that 85% of the commuters they surveyed insisted on meeting the other members of a carpool before making a commitment to join. Employer-based programs provide a ready framework for personal introductions. Indeed, personalized placement is the defining characteristic of the most successful ride-brokering programs.

How successful have such programs been? Evidence from recent studies indicates that companies that make a sustained, full-time commitment to transportation brokerage are able to achieve significant results. Table 7-5 shows the performance of leading employer- based programs. Reported trip reductions range from *5.5%* to 48%. The common feature of these exemplary programs is the provision of a wide range of commute alternatives, including carpooling, vanpooling, and improved transit service.24

TABLE 7-5
Results from 11 of the Nation's Leading Brokerage Programs

Location	Company	Travel Base	Vehicle Trip Rate	Percent Reduction
Hartford, CT	Travelers	10,000	42.8	25.4%
Hartford, CT	Hartford Steam Boiler	1100	49.6	13.6%
St. Paul, MN	3M Company	12,000	82.7	9.7%
Bellevue, WA	US WEST	1150	45.2	47.6%
Bellevue, WA	CH2M Hill	400	59.4	31.2%
Bishop Ranch, San Ramon, CA	Pacific Bell	6900	72.827.8%	
Hacienda Business Park, Pleasanton, CA	AT&T	3890	80.5	13.4%
Los Angeles, CA	UCLA	18,000	79.0	5.5%
Los Angeles, CA	ARCO	2000	55.3	19.1%
Orange County, CA	State Farm	980	64.3	30.4%

Montgomery County, MD	Nuclear Regulatory Commission	1400	53.7	41.6%

aThe vehicle trip generation rate, expressed as the number of vehicle trips/100 travelers. The rate assumes 2.5 persons/carpool, 12 persons/vanpool, and 30 persons/transit trip.

Source: Adapted from J. Richard Kuzmyak and Eric N. Schreffler, *Evaluation of Travel Demand Management (TDM) Measures to Relieve Congestion,* prepared by COMSIS Corporation in association with Harold Katz & Associates (Washington, D.C.: Federal Highway Administration, 1990), p. 26.

A study of Los Angeles programs points to the importance of full-service transportation brokerage. The average mode split for a firm with 1000 employees and no personalized matching assistance was approximately 89% drive alone, 8% ridesharing, and 2% public transit use. The average mode split for a firm with 1000 employees that provides a typical level of personalized matching assistance was 78% drive alone, 19% ridesharing, and 2% public transit use.25

Can these results be sustained over time? A 10-year evaluation of San Francisco-

based programs found that only a handful of the region's largest cmployers and developers have made the long-term commitment necessary to institutionalize and sustain full-service brokerage. Scores of other companies have started programs and achieved initial success, only to see performance wane as commitment lapsed.26

MULTIEMPLOYER RIDE BROKERING

If permanent employer programs were the most important ridesharing innovation of the 1980s, multiemployer programs promise to be the most important organizational innovation of the 1990s. Multiemployer programs can take many forms, ranging from adjacent companies sharing an employee transportation coordinator, to formal arrangements called transportation management associations (TMA). A TMA is an organization through which employers, developers, and local government can cooperate in providing brokerage and marketing services jointly or cooperatively. There was significant growth in the number of TMAs during the late 1980s. In 1987, there were approximately 20 TMAs nationwide. But by 1989 there were 55 established and emerging TMAs and that number is expected to increase rapidly in the future.27 In California alone, the state Department of Transportation has awarded some $2.2 million in seed grant funds to 44 emerging TMAs.

The motivation for starting a TMA can vary widely. In some cases, the catalyst has been a business concern that congestion will lead to stifling limits on future growth. In other cases, the need for a TMA has sprung from a local trip-reduction ordinance or air quality ruling.

A TMA typically provides at least some of the following services:28

• *Information on commute options* including buses, vanpools, and carpools.

• *Ridesharing assistance* tailored to localized needs.

• *Promotional materials* designed to promote the benefits of commute alternatives.

° *Procurement of services,* including club buses, shuttles, or emergency rides home.

• *Advocacy planning,* including efforts to implement improved transit services or municipal bikeways.

• *Management consulting* on alternative work-hour programs, telecommuting, and parking pricing policies.

The genesis of a TMA is normally attributed to a prime advocate, who mobilizes support for cooperative effort—often a "public-private partnership." For example, the Bishop Ranch Transportation Association, one of the most successful TMAs in the San Francisco Bay area, was formed at the instigation of a major developer, who saw ridesharing and a shuttle service as a way to alleviate environmental concerns and to enhance the marketability of a 20,000-employee office-park development project.29

Many TMAs are satellites of an existing organization, such as a chamber of commerce or industrial association, and share staff with the parent organization. For

example, the Century City TMA in Los Angeles is part of the chamber of commerce and operates on a fee-for-service basis. The service area for a TMA is typically a few square miles. An example of a citywide TMA is the Joint Institutional Transportation Brokers Association in San Francisco, which includes all the city's major hospitals and universities.

The formation of TMAs to implement multiemployer ride brokering is a fairly recent phenomenon, and there has been no opportunity to evaluate their long-term effectiveness. The best available evidence indicates that a well-run TMA can have a significant impact on ridesharing rates. In Bellevue, Washington, carpool and vanpool participation rates for the area served by an effective TMA are 19% compared to control site rates of 12%.30 At the Hacienda Business Park in Pleasanton, California, ridesharing rates are 18% compared to 12% in Pleasanton at large.31 And, at Bishop Ranch in nearby San Ramon, the ridesharing rate is 28% compared to an ambient rate

of 24%.32 Such results indicate the promise of multiemployer programs, but it should also be noted that these results are from leading TMAs, not necessarily typical ones.

LOCAL GOVERNMENT REGULATION

An increasing number of sunbelt cities and counties are using their regulatory powers to mandate employer and developer involvement in ridesharing and other traffic mitigation efforts. Mandatory programs are gradually displacing voluntary ones as localities seek antidotes to employer and developer commitments that are halfhearted or short-lived. The trend is toward binding contractual requirements for developers and mandatory employer programs based on explicit performance requirements.

Conditions on Development Approvals

Since new development generates traffic, local governments can place conditions on developer permit approvals to mitigate traffic as long as the requirements are reasonably necessary to the protection of the public health, safety, and general welfare. Although most conditions on development approvals relate to supply-side improvements, such as improved signalization or additional access road capacity, many local jurisdictions negotiate traffic mitigation requirements with development sponsors. Probably the most extensive set of mitigation requirements are in the city of San Francisco, where approvals of all major mixed-use commercial development projects over the past decade have included transportation brokerage as a condition on development approval.33 Requirements include sale of public transit tickets, distribution of ridesharing information, provision of priority parking for carpool vehicles, establishing parking rates that encourage ridesharing, and conducting surveys to monitor program performance.

Incentive Ordinances

A growing number of municipalities have adopted ordinances to create a legal obligation for employers and developers to alleviate local traffic. Two different types of ordinances have emerged: (1) incentive ordinances and (2) trip-reduction ordinances.

Incentive ordinances typically offer developers reduced on-site parking requirements. In return, the developer agrees to implement specified traffic mitigation measures. Some jurisdictions such as Sacramento,

California, have established a schedule of permitted parking reductions based on specific actions. Ridesharing programs enable developers to reduce parking allowances 10 to 20%.34 Other cities negotiate agreements on a case by case basis. In Orlando Florida, under a 1982 ordinance, a developer could avoid the construction of up to 20~o of required parking in exchange for contributions to a transportation management trust fund.35

To date, there has been little diffusion of incentive ordinances. Developers have been reluctant to provide less than "adequate" parking and are fearful that lenders would balk at financing such projects.

Trip-Reduction Ordinances

The most common type of ridesharing ordinance is a trip-reduction ordinance. The first such ordinance was adopted in Placer County, California, in 1981. But it was a 1984 ordinance adopted in Pleasanton, California, that has been most imitated. Developers and the city of Pleasanton worked together to design an ordinance to reduce drive-alone commuting during peak hours.36 The ordinance embodies two standards: a required level of peak-hour trip reduction and an operating standard for the community's arterial street system. The basic standard is a 55% limit on the percentage of the work force that drives to and from work alone in the peak hour. Compliance requires employers and developers to either stagger work hours or induce their employees to share a ride. Most companies employ both approaches.

Following Pleasanton's example, most trip-reduction ordinances apply to both new and existing development. Ordinance goals are typically expressed as a performance standard: a participation rate for ridesharing, a target vehicle-occupancy rate for the peak period, or a level-of-service standard for local intersections. Some ordinances require implementation of specific TSM measures, but most leave the specifics of implementation to employers or developers. When specific actions are required, less stringent requirements are typically placed on smaller employers than larger ones. No known ordinance requires attainment of trip-reduction goals; rather, evidence of good faith effort is normally sufficient. Most ordinances assign oversight authority to either an advisory committee or task force.37

The adoption of multicity trip-reduction ordinances seems to be the likely next stage in the regulation of generated traffic. Five California cities—Belmont, Foster City, Redwood City, San Carlos, and San Mateo—have adopted the same trip-reduction ordinance.33 Unique features of this subregional ordinance include (1) uniform

requirements on all employers in the five-city area, (2) a per-employee fee designed to finance program implementation, and (3) multicity administration by a TSM coordinator. Similar subregional approaches are being considered in two other California counties, Marin and Santa Clara.

CORRIDOR PLANNING FOR BUSES, CARPOOLS, AND CONGESTION MANAGEMENT

Since the 1970s, state highway departments have made increasing efforts to incorporate special facilities for buses and carpools in their plans for highway development. Measures that have been implemented include reserved lanes for buses and carpools (high-occupancy vehicle lanes); ramp metering with preferential entry (the reconstruction of freeway ramps to enable buses and carpools to bypass the queue at metered ramps); park-and-ride facilities; and the incorporation of transit transfer centers and park-and-ride facilities within the geometric envelope of freeway projects. The objective, of course, is to transform freeways into multimodal transportation facilities with increased peak-hour people-carrying capacity. These efforts have been stimulated by changes in federal funding arrangements that have made auxiliary facilities eligible for federal reimbursement. Further stimulus has come from a new federal program that allows state highway departments to use federal highway funds for transit operations and ridesharing programs *during highway reconstruction.*

Many observers believe that this program could represent a first step toward active state and federal involvement in *ongoing* traffic management programs that provide long-term funding for bus-on-freeway rapid transit and corridor-scale ride-brokering campaigns. Table 7- 6 outlines the elements of a comprehensive congestion management program—an idealized program that could be implemented if funding were more flexibly available for ongoing traffic management programs and localities were actively engaged in the process of corridor planning.

As the table shows, a large number of organizational innovations would be necessary to implement a comprehensive congestion management program. And, to date, most metropolitan areas lack the organizational infrastructure—the consensus, financing, and institutional arrangements—to implement comprehensive traffic management programs. Thus, no corridor planning effort has embodied the thorough integration of infrastructure design, transit operation, ridesharing, and land-use controls that are outlined in the table.39 Existing plans typically emphasize the facilities element of a comprehensive program, leaving integration and the implementation of complementary elements to chance.

HOV LANES AND RAMP METERING

HOV lanes and ramp metering are the most commonly implemented elements of present plans. HOV lanes enhance freeway operation by (1) adding capacity and (2) enabling buses and carpools to bypass congestion.40 In turn, time savings realized by buses and carpools provide an incentive for transit use and carpool formation. Ramp

TABLE 7-6
Elements of a Comprehensive Traffic Management Program for a Congested Urban Corridor

Elemcnt	Innovation Required
Infrastructure	
• HOV lane.	* None
• Integration of transit stations in freeway design.	* State funding for transit stations and transfer centers
• Integration of park-and-ride facilities in interchange design.	* Dedicated funding for part-and –ride facilities Within the state highway program.
• Reconstruction of ramps to increase storage capacity.	* None
Highway operations	
• Ramp metering with priority entry for buses andcarpools.	* None
• Geometric metering to keep mainline and ramp inputs in equitable balance.	* Modification of planning and design guidelines to recognize the constructive role that bottlenecks can play in the operation of the highway system.
Transit operations	
• Expansion of bus operations to provide bus-on-free way rapid transit.	* State financing for transit operations with parti- Cipation based on a share of direct operating ex- penses.
° Operation of shuttle-service connections to major employment centers.	* Coordination of mainline services with comm.- Unity-level transit, paratransit, and shuttle services.
Land use	
• Adoption by localities of a common or universal mitigation ordinance establishing Limits on work-site traffic generation.	* Joint agreement by multiple local governments, including joint limits on work-site parking.
° Agreement by localities on a multijurisdictional growth budget that establishes ceiling allowances for commercial and industrial development.	* Joint agreement on growth limits and allowances.
Ridesharing	
• Creation of a TMA with a corridor-scale scope of operation.	* Tripartite state, local, and private Financing for TMA operations.

metering enhances freeway operation by (1) giving mainline movement priority over merging vehicles, (2) breaking up platoons of merging traffic, and (3) limiting the density of freeway traffic so as to sustain stable flow. The appropriateness of ramp metering or HOV lanes is situational. Ramp metering is unlikely to be appropriate where ramps are cramped and provide limited storage capacity. HOV lanes are unlikely to be appropriate where initial vehicle occupancy is low and short trips are prevalent. In other words, the effectiveness

of ramp metering is contingent on the availability of ramp capacity; the effectiveness of HOV lanes is contingent on significant time savings for HOVs and relatively high levels of ridesharing and transit use prior to implementation.41

Table 7-7 shows the productivity of HOV lanes implemented during the 1970s and 1980s. As the table indicates, the productivity of HOV lanes is highly variable. At the high end of the range is the Shirley Highway HOV lane, which serves 7100 passengers per hour, including 5530 bus passengers. At the low end of the range are a number of facilities that serve passenger volumes only marginally greater than a freeway lane that is used for mixed traffic. HOV lanes with high levels of productivity share a common

TABLE 7-7
Productivity of Transitways and HOV Lanes in the United States and Canada
(am. peak-hour vehicles and passenger volumes)

Facilities	Buses	Bus Passengers	Van/Carpool Vehicles	Van/Carpool Passengers
HOV lanes sharing freeway ROW				
Exclusive facilities				
1. Houston, Texas				
I-10 (Katy)	35	1235	115	620
I45 (North)	70	2490	180	1470
2. Los Angeles, I-10 (El Monte)		75	3450	9052860
3. Washington, D.C.				
I-395 (Shirley)	150	5320	1890	8880
I-66	70	2450	2365	8810
Concurrent flow				
1. Honolulu, Moanalua Fwy.	—	—	—	—
2. Los Angeles, Rte. 91	NA	NA	NA	NA
3. Miami, I-95	9	350	1300	2460
4. Orange County, Calif., Rte. 55		2	5o	11002310
5. Orlando, Fla., I-4 North/South		—	—	— —
6. San Francisco, Calif.				
S.F.-Oakland Bay Bridge	200	6320	3000	10,850
U.S. 101	70	2590	360	1100
7. Seattle, Wash.				
I-5	55	2160	404	1130
SR 520	55	2300	255	1060
Contraflow				
1. Honolulu, Kalanianole Hwy.	10	510	205	810
2. New York City, NJ Rte. 495	725	34,685	NA	NA

3. San Francisco, Calif., U.S. 101		NA	NA	NANA
Transitways with separate ROW				
1. Ottawa, Canada				
Southeast Transitway	156	8100	NA	NA
West Transitway	132	6900	NA	NA
Southwest Transitway	92	4200	NA	NA
2. Pittsburgh, Pa.				
East PatWay	105	5590	NA	NA
South PatWay	75	2950	NA	NA

Source: Adapted from Institute of Transportation Engineers, *The Effectiveness of High-Occupancy Vehicle Facilities: An Informational Report* (Washington, D.C.: Institute of Transportation Engineers, 1988).
characteristic: all carry significant numbers of buses and bus passengers. HOV systems to cover an entire urban area are now emerging. They offer the opportunity to encourage urban ridesharing with diverse trip ends.
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REGIONAL RIDESHARING AGENCIES

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There is a surprising diversity of organizational and funding arrangements for regional ridesharing agencies. There are successful examples of regional ridesharing agencies sponsored by state departments of transportation, metropolitan planning organizations, councils of government, public transit operators, private nonprofit corporations, counties, and even universities.

Most ridesharing agencies are actively engaged in the employer-based ridesharing, transportation management associations, and corridor-level strategies discussed previously. Basic functions include:

Ride information for both existing and potential carpoolers and vanpoolers. Most matching systems are computerized, with the trend toward interactive systems that allow a full array of searches, for example, along a corridor. Some agencies provide more personalized assistance and make follow-up calls to see if the match list was useful.

. Marketing activities through one of three traditional channels: through employers to employees, via mass media to the public directly, or to workers at their place of residence. The "selling" of commute alternatives is a major emphasis of most ridesharing agencies.

Assisting vanpool formation by meeting with prospective vanpoolers, monitoring vanpool vendors to make sure vanpool groups get what they need, and providing information on laws affecting vanpools.

• Contracting for more specialized services, such as managing a TMA.

Regional ridesharing agencies can play an important facilitation role in promoting an increase in vehicle occupancy. However, several factors beyond the authority of regional ridesharing agencies influence their effectiveness.

FACTORS INFLUENCING THE EFFECTIVENESS OF CONGESTION MANAGEMENT

In a growing number of suburban communities across the United States, state and local authorities are relying on increased vehicle occupancy to accommodate future traffic growth. For this strategy to succeed, traffic mitigation programs must produce results that are both significant and sustainable, and such results are difficult to achieve. Recent research indicates that the performance of ridesharing programs is "highly variable, subject to change over time, and influenced by variables outside manager control."42 Results are "contingent rather than certain"43 and "can reduce traffic on highways by small amounts, and on local streets by more significant amounts."44 In other words, caution is indicated. Ride brokering and other traffic mitigation measures can dampen the growth of congestion, but cannot offer an alternative to capital investment for communities that are experiencing rapid growth in employment and population. Exemplary programs have demonstrated the potential of employer-based ride brokering, but the success of such programs depends on a "chain of ifs." The most significant "ifs" that affect performance are itemized in Table 7-8.

TABLE 7-8
Factors Influencing the Effectiveness of Employer-Based Ridesharing Programs

	Factors That Enhance Effectiveness	Factors That Limit Effectiveness
Program management	Appointment of a permanent Transportation coordinator.	No permanent assignment of Administrative responsibility.
	Training for coordinator.	Ambivalent support from top management.
	Long-term support from top management.	
Program style	Work-site program provides personalized, one-to-one services and offers a full menu of commuting alternatives.	Work-site program relies on regional ridesharing agency to provide most services, including employee contact.

	Work-site program relies on the regional ridesharing agency for technical services, but not employee contact.	
Parking policies	Close-in parking is reserved for carpools.	Parking is free and space is made available to all comers.
	Carpools are registered and new employees are encouraged to join existing carpools.	Existing carpools not sustained
Employer size	More than 2000 employees (the scale threshold necessary to justify employment of a full-time commute coordinator).	Fewer than 500 employees at the work site or employment cluster.
Travel patterns	A sizable proportion of work force lives more than 15 miles from the work site.	Most employees are drawn from communities in the immediate vicinity of the work site.
Mix of land uses in the immediate vicinity of the work site	Mixed land use satisfies midday needs and creates a pleasant environment for walking	Midday needs cannot be satisfied without driving during the lunch hour.

The implications of Table 7-8 are important. The first is that the effectiveness of ride-brokering programs is contingent on a host of factors beyond administrative control. The second is that large companies that develop professionalized programs with a personal touch can offer their employees compelling alternatives to driving alone. And the third is that most companies are not large enough to develop fully professionalized programs or a full menu of alternatives. The third point is crucially important, because only about a quarter of the metropolitan work force is employed

by companies large enough to develop full-service brokerage programs. In turn, this means that the ability of most employers to participate in ride brokering effectively depends on the future development of multiemployer ridesharing associations and the implementation of comprehensive corridor plans. In other words, the opportunity for more employers to participate effectively in ridesharing programs hinges on an organization-building process that is underway, but far from complete.

A generation ago urban geographers could speak of the prototypical American city—a nuclear city with a predominant core and central industrial areas surrounded by an inner ring of multistory, multifamily apartment buildings and row houses, encircled in turn by successive generations of suburban housing. The suburbs of this prototypical American city were dependent on the central city for employment and, in turn, housed a growing share of its work force.45

The imagery of the nuclear city continues to inform our thinking about urban geography, but such imagery bears less and less resemblance to urban reality. This is because the growth of the service and information industries has transformed suburbs from bedroom precincts into commercial and industrial districts of metropolitan significance. Suburbs have become cities—in function, if not density—and the result is a profound change in metropolitan employment and travel patterns.46

Table 7-9 shows the travel patterns that prevailed in 1980 in the nation's 25 largest urbanized areas. As it shows, 52% of all metropolitan workers were employed in the suburbs. By comparison, only 8% of the work force commuted to jobs in the central business district (CBD). As these data indicate, the imagery of the nuclear city no longer describes the geography of employment or commuting in most American cities. The nuclear city has evolved into a loosely clustered metropolitan complex.

With the growth of suburban employment has come (1) an increase in crosstown and suburb-to-suburb commuting; (2) an increase in trip making from outer suburbs to inner suburbs, that is, an increase in trips to intermediate suburban destinations along radial corridors that lead to the central city and the CBD; (3) an increase in the proportion of trips that end at suburban work sites where parking is free and plentiful; (4) an increase in the proportion of trips for which mass transit is noncompetitive; (5) an increase in the share of urban commute trips made by workers driving alone; and (6) an increase in suburban congestion.

Increased congestion in the suburbs and in radial corridors has given impetus to the congestion management efforts discussed in the previous section. Such plans are an apt but partial response to suburban transportation problems. These plans respond to commute period congestion by enhancing the availability and attractiveness of commute alternatives that serve trips considerably longer than the average. But congestion management plans typically fail to diversify the travel options available for

TABLE 7-9
Metropolitan Commuting Patterns in 1980:
Work.-Trip Travel in the Nation's 25 Largest Metropolitan Areas

Commute Pattern	Share of All Commute Trips
Trips that begin and end in the suburbs.	45.7%
Trips that begin in the suburbs and end in the CBD.	3.7%
Trips that begin in the central city and end in the CBD.	4.7%
Trips that begin in the central city and end in the suburbs.	6.8%
Trips that end in the central city. but not in the CBD.	39.0%

Source: Adapted from William O'Hare and Milton Morris, *Demographic Change and Recent Worktrip Travel Trends,* prepared by the Joint Center for Political Studies for UMTA, Technical Assistance Program, Report no. UMTA-DC-09-7009 (Washington, D.C.: U.S. Department of Transportation, February 1985).

short commutes and off-peak travel. In central cities, this is the segment of the travel market served by street transit—buses, streetcars, and trolley buses. But in the suburbs, low-density land use and the pattern of the street network prevent transit agencies from operating services that provide comparable suburban coverage. Instead, most suburban transit systems are designed to provide feeder service to trunk-line rail or bus systems that serve the CBD. In other words, suburban bus systems are typically designed to serve the travel patterns of the nuclear city. Such services are a chance fit with short, intrasuburban commutes and the dispersed travel patterns characteristic of off-peak suburban travel. As a result, bus systems designed to provide trunk-line feeder service offer a noncompetitive alternative for most suburban trips. A 1985 UMTA study showed that the transit share of suburb-to-CBD commute trips in 1980 was 55%, while the suburb-to-suburb share was only 2.7%.47

Dial-a-ride systems were developed to serve suburban areas, and this is the form of transit service best matched to the largest number of suburban trips. But the deployment of demand-responsive services has been preempted by the operation of conventional bus systems designed to provide feeder service. This has left most suburban residents without service that is attractive for intrasuburban travel.

Considering the high levels of automobile ownership found in the suburbs, transit planners are not inclined to view this outcome as a critical problem—and for the majority of the suburban population it is not. But it can be a problem for some segments of the population. These include:

- Teenagers who experience enforced isolation.
- First-time workers who would prefer to defer the cost of automobile ownership, but have no acceptable alternative.
- The stay-at-home member of two-adult, one-car households.

• First-time home buyers who would prefer to defer the purchase of a second car, but have no acceptable alternative.

• Older residents who are no longer confident of their driving skills.

In many suburbs, descriptors such as these characterize one-quarter to one-third of the population.48 In other words, enforced isolation and involuntary reliance on the automobile are much more pervasive than most planners recognize. In turn, this argues for reconsideration of the mix of transit services offered in suburban communities. Specifically, it argues for the consideration of hybrid systems that provide fixed-route feeder service during the peak period and demand-responsive services during off-peak hours. Such a radical service innovation may be inappropriate for many communities. It is presented here not as a sure thing, but as an invitation and challenge to design transit services that match the travel patterns of the nonnuclear metropolis.

PLURAL TRANSPORTATION AND AIR QUALITY

The Clean Air Act and subsequent amendments call for the planning and implementation of transportation control measures (TCMs). Transportation control measures are synonymous with "transportation controls" and "transportation air quality measures." Table 7-10 lists the control measures that the U.S. Environmental Protection Agency (EPA) has endorsed as "reasonably available" for metropolitan implementation. Carpooling programs and other efforts to increase vehicle occupancy are prominently featured on the EPA list and are prominently represented in the control plans developed for metropolitan areas that violate air quality standards. In the pages that follow, we will examine the effort to harness plural transportation as a pollution control measure.

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The Clean Air Act of 1970 required the development of state implementation plans (SIPs) for bringing air quality up to national standards through controls on both stationary and mobile pollution sources. Control of stationary sources such as factories and power plants has proved relatively easy to accomplish using a conventional regulatory approach: set standards and exact compliance. But mobile sources of pollution—autos and trucks—are difficult to control using conventional regulatory methods. This is because mobile-source controls imply changes in individual travel behavior. In turn, their implementation requires the cooperation or compliance of individual travelers and truckers in large numbers.

TABLE 7-10

EPA's List of Reasonably Available Control Measures

Voluntary No-Drive Days
Trip Reduction Ordinances
Employer-Based Transportation Management
Work-Schedule Changes
Rideshare Incentives
Improved Public Transit
Traffic Flow Improvements
Road Pricing/Tolls
Parking Management Programs
Park .£ Ride Fringe Parking
Control of Extended Vehicle Idling
Reduction of Cold-Start Emissions
Gasoline Fuel Additives
Conversion of Fleet Vehicles to Cleaner Fuels or Engines

The first generation of transportation control plans—developed with the U.S. Environmental Protection Agency in a lead role—can be described most accurately as a learning experience. Planners accustomed to the command-and-control methods of regulatory rule making had to learn through trial and error how to devise plans appropriate to the atomistic environment of personal transportation.50

Many first-generation plans included measures that the public perceived as draconian or punitive—measures such as gas rationing and parking surcharges. These measures galvanized almost instant opposition and forced the EPA to postpone its original 1977 deadline for implementation of TCMs. But the first generation of plans was not wholly fruitless. Some TCMs—the creation of regional ridesharing programs and the involvement of employers in ridesharing—proved widely acceptable and have been incorporated in second-generation plans. More important, air quality planners learned that control plans could not be implemented either hastily or unilaterally: effective air quality planning requires a long-term commitment to the creation of a broad-based social partnership.

This orientation influenced the 1977 Clean Air Act Amendments, which placed new emphasis on the establishment of a participatory, continuing process for air quality planning and decision making. The 1977 legislation also articulated detailed expectations for transportation controls, making regional controls a key strategy of the Clean Air Act.

IMPLEMENTATION EXPERIENCE

By the early 1980s, most major metropolitan areas had implemented the voluntary carpool and vanpool programs proposed in the first generation of control plans. Implementation responsibility was typically assigned to a regional ridesharing agency, and the control orientation of the initial plan was replaced by the service orientation typical of ridesharing agencies. This softening of orientation has produced extensive implementation of ridesharing programs, but the air quality impact of these programs has been limited.

Four factors limit the potential for voluntary, employer-oriented programs to achieve significant reductions in pollutant emissions:

1. Such programs target work trips that account for only 20 to 25% of all urban trip making.

2. Carpooling is an uncompetitive alternative for most work trips—because most work trips are short and end with free parking. (Due to "cold starts" and "hot soaks" it is trip reduction, not VMT reduction that makes the primary contribution to emissions reduction.)

3. Large employers—those with 100 or more employees—employ less than half of the metropolitan work force.51

4. Employer commitment to voluntary programs tends to erode with time.

Because of these limiting factors, a vigorous but voluntary ridesharing effort cannot be expected to reduce automotive emissions by even 1% in most metropolitan areas.52 A vigorous program paired with incentives such as HOV lanes and preferential parking could achieve emission reductions somewhat greater. But pairing with forceful incentives (a financial bonus for carpooling) or with aggressive disincentives (such as parking charges) is necessary to obtain truly significant reductions in automotive emissions. Ridesharing programs paired with aggressive pricing and regulatory policies that impinge on both work and nonwork travel could reduce automotive emissions by 5% or more.53 To date, metropolitan policy makers have been understandably reluctant to endorse policies that are sufficiently aggressive to achieve such results.

But it is just such issues that policy makers have been forced to confront as voluntary efforts failed to meet the compliance requirements of the Clean Air Act. Failure to comply with federal standards has forced a second round of control planning in some 15 metropolitan areas. All of California's major metropolitan areas violate Clean Air Act standards, and it is in California that the question of stringent disincentives is receiving the most earnest debate. Thus it is instructive to examine the progress of control planning in Los Angeles and the San

Francisco Bay area. In Los Angeles, regional authorities have adopted a stringent regulatory approach to the implementation of employer carpooling programs. In San Francisco, regional authorities are debating a dramatically different approach—one that emphasizes the use of price incentives.

Mandatory Ridesharing in Los Angeles

Los Angeles is the nation's most heavily polluted air basin, and its plan for pollution abatement entails the nation's most aggressive use of regulatory powers to influence commute behavior. The regulatory approach adopted in Los Angeles requires *employers* to adopt and implement plans that will induce their *employees* to carpool and vanpool.54 Employer compliance is mandatory, and the standard of compliance is the attainment of a specified level of vehicle occupancy: 1.75 persons per vehicle in central Los Angeles, and 1.3 persons per vehicle in suburban Los Angeles. These attainment targets reflect the vehicle-occupancy rate necessary to increase aggregate vehicle occupancy from its present level—1.13 persons per vehicle—to a regional standard of 1.5 persons per vehicle.

The mandatory standard—called Regulation XV—has been adopted by the South Coast Air Quality Management District and presently applies to all employers of 100 or more employees in a four-county area. Regulation XV requires employers to adopt a plan for meeting the average vehicle ridership (AVR) standard, provide whatever incentives are necessary to implement the plan, and employ a professional transportation coordinator to implement the plan. Employers are not penalized if they fail to meet the average vehicle ridership target (1.3 or 1.75), but they can be fined if they fail to submit a trip-reduction plan or fail to offer reasonable incentives as part of the plan. The incentives provided must be sufficient to achieve the AVR target within 12 months—a requirement that has motivated many employers to provide financial bonuses for employees who pool. These carpooling bonuses seem to be the new element that distinguishes Regulation XV plans from employer-based ridesharing efforts in other areas.

The implementation of Regulation XV is still in progress, and thus it is too early to determine whether employers will be willing and able to muster incentives sufficient to induce the changes in travel behavior that the regulation contemplates. If the Air District's targets are met, it is estimated that Regulation XV will reduce carbon monoxide by 100 to 216 tons per day, hydrocarbon emissions by 11 to 24 tons per day, and nitrogen oxide emissions by 16 to 34 tons per day.55

Air Quality Planning in the San Francisco Bay Area

The San Francisco Bay area has relatively clean air compared to Los Angeles, but nonetheless fails to meet federal air quality standards. Moreover, it is expected that the growth of population and urban activity will

degrade air quality faster than automotive emission controls can reduce tailpipe emissions. Thus, regional authorities are obliged to implement transportation control measures.

In 1982, the region obtained federal approval for a control plan that emphasized mandatory vehicle inspection and maintenance and voluntary increases in ridesharing and transit use. But by 1988 it was clear that the region would not achieve timely compliance with federal air quality standards because vehicle inspection was contributing lower-than-projected emission reductions, while the growth of suburban employment was obsoleting projected increases in carpooling and transit use. Clean Air Act compliance required the adoption and implementation of additional TCMs, and the Bay Area initiated a new round of air quality planning in 1988.56 Its compliance efforts were augmented under court order in 1989.

This new planning effort has been informed by a conscious decision to follow a path different from that pursued in Los Angeles. Public officials in the Bay Area are debating pricing policies that would discipline automobile use while providing a stream of revenues sufficient to improve transit service significantly. This approach emphasizes pricing policies that would impinge on travelers directly, rather than regulatory policies

that would impinge on travelers indirectly.57 Their approach was first proposed by a business-oriented group hopeful of using a market-oriented strategy that employees *congestion tolls* and *pollution pricing.* Their approach has been endorsed by an array of business leaders who hope to avoid the direct involvement and regulatory entanglement of the Regulation XV approach in Los Angeles. It has also been endorsed by the environmental groups that obtained the court order forcing timely adoption of new TCMs.

The theoretical argument for congestion tolls and pollution pricing is well known, as are the practical difficulties associated with the implementation of full-costing pricing. Those practical difficulties have led regional planners to emphasize look-alike measures that are proxies for pricing: increased bridge tolls, increased vehicle registration fees (keyed to emissions performance), and, perhaps, parking fees and surcharges.58

Regional approval for a pricing-oriented plan remains uncertain, as does the passage of state implementing legislation. Nonetheless, the Bay Area's nascent commitment to pricing provides an instructive example of a market-oriented strategy with the potential for impacts as significant as those expected from Regulation XV.

In the Bay Area, Los Angeles, and elsewhere, the process of control planning has forced policy makers to grapple with issues that are inherently difficult and controversial: for the short term, how to induce willing change in travel behavior; for the midterm, how to induce significant further improvement in the technology of emissions control; and for the long term, how to grow cities that are less exclusively reliant on the individual use of private transportation. The California experience suggests that we are close to answering the first and second questions, but far from answering the third.

PLURAL TRANSPORTATION AND ENERGY CONSERVATION

Energy conservation has been an intermittent priority of U.S transportation policy. During wartime, the United States behaves like an oil-importing nation and gives priority to conservation. During peacetime, the United States behaves like an oilproducing nation and allows conservation efforts to lapse. The United States is, of course, both an oil-importing and an oil-producing nation, and this duality explains the ambivalence of U.S. policv toward conservation.

The ambivalence of U.S. conservation efforts can also be explained by the relative recency of the nation's heavy dependence on imported oil. As late as 1970, imported petroleum accounted for only 23% of U.S. fuel consumption—an acceptable level of international risk exposure.59 But by 1973, the first year of the Arab oil embargo, imports accounted for 36% of U.S. consumption, and by 1990 imports accounted for half of U.S. consumption—a patently unacceptable level of risk exposure. The 1990 "Oil War" indicates both the level of risk and the importance of oil to the nation's economy.

Most of the world's industrial nations have imposed a vanity or vice tax on motor fuels to provide a persistent incentive for conservation.60 The United States has not,

relying instead on emergency rationing, an emergency oil reserve, and the public's responsiveness to emergency conservation campaigns. In other words, most elements of U.S. transportation energy policy involve standby measures that can be implemented if and when crises occur. Regulatory standards for motor-vehicle fuel economy are a notable exception. They are the nation's only significant long-term commitment to transportation energy conservation.

As we have noted, carpooling campaigns were instigated during World War II, the Korean conflict, and the energy crisis of the 1970s. Ridesharing campaigns square with the crisis orientation of U.S. transportation energy policy: they can be implemented on a contingency basis, and their implementation does not entail long

lead times or major start-up costs. As important, carpooling campaigns take aim at a big target—the 34% of vehicle-miles traveled for work-related purposes. But the size of the target should not lead to exaggerated expectations that carpooling programs can have significant impacts on national energy accounts. Table 7-11 shows that it would take a 17% nationwide increase in carpooling to achieve a 1% reduction in VMT, and that a "realistic" 5% increase in work-related ridesharing would reduce daily oil consumption only two-tenths of 1%. Carpooling programs obviously have extremely limited leverage on the nation's aggregate oil requirements. Such programs enable individual commuters to realize significant savings in the cost of commuting, but the potential for translating individual monetary savings into national energy savings is inherently limited.

TABLE 7-11
Commuter Carpooling in the Context of National Energy Accounts

Share of U.S. oil consumption used for transportation.	63%
Personal transportation's share of transportation energy consumption.	69%
Work-related VMT as a share of total daily VMT.	34%
Share of work-related VMT logged by carpools and vanpools.	19%
Carpool/vanpool share of total VMT.	7%
Increase in carpooling and vanpooling necessary to reduce automotive VMT by 1%.	17%
Reduction in nationwide energy consumption attributable to a 5% increase in organized carpooling.	0.2%

Source: Calculated from data supplied by the American Petroleum Institute and the *Nationwide Personal Transportation Study, 1983-84.*

The prospect for using carpool programs to achieve long-term energy conservation goals is even more discouraging. The typical ridesharing program provides services, not incentives. And in the absence of crisis conditions, powerful incentives would be necessary to overcome the erosion of informal ridesharing arrangements that is occurring with the suburbanization of employment and the continuing growth of

automobile ownership. Background trends are eroding informal ridesharing arrangements faster than ridesharing programs can field formal carpools and vanpools. Indeed, the mismatch is overwhelming. Ridesharing's

contribution to metropolitan mobility declined sharply from 48.0% of the total VMT in 1977 to 42.6% in 1983.61 There is no doubt that the work of ridesharing agencies retarded these trends—for example, the share of VMT logged by vanpools increased fourfold—but these efforts were overwhelmed by countervailing social and economic trends.62

SUMMARY

Plural transportation is a family of transportation services that lies intermediate between personal and mass transportation. It is a diverse set of market-specialized transportation services and organized travel arrangements that make collective use of private transportation. Plural transportation plays an important role in America's mix of transportation modes. Passengers riding in cars, vans, and trucks account for almost 32% of the mileage traveled in metropolitan America. The collective use of private vehicles provides Americans with a source of mass mobility that other nations have sought from public transportation.

Recent efforts to organize and facilitate ridesharing and paratransit entail three distinguishable thrusts: (1) efforts to promote carpooling and vanpooling to serve commute trips, (2) efforts to field transitlike services with the routing and scheduling flexibility necessary to serve small towns and outlying suburbs, and (3) efforts to provide specialized transportation services for the elderly and handicapped.

Public policy has placed high expectations on plural transportation. Dial-a-ride systems were touted as an opportunity for transit to capture urban market shares in suburban communities. Ridesharing programs were first advertised for their contribution to energy conservation and have become a cornerstone of suburban plans for congestion management and air quality improvement. Paratransit has been asked to provide a mobility lifeline for the elderly and handicapped. Thus, small programs have been assigned large missions. At the same time, the results that could be expected from such programs were being overwhelmed by countervailing forces—the growth of suburban employment centers, the growth of sunbelt cities, and the growth of women's labor-force participation.

The rapid growth of suburban population and employment has resulted in the increasing prevalence of suburb-to-suburb trips that end at a workplace that provides abundant free parking. Sharp increases in the rate of women's labor-force participation have produced corresponding increases in the proportion of two-income, two-car households, with the average number of vehicles per household increasing from 1.2 to 1.7 between 1969 and 1983. These geographic and demographic trends have countermanded recent efforts to increase auto occupancy through ridesharing. Between 1969 and 1983, work-trip auto occupancy in metropolitan America dropped from 1.4

to 1.2. Consequently, ridesharing's aggregate contribution to energy conservation, air quality, and metropolitan mobility has declined—despite the best efforts of carpooling programs.

Although efforts to increase vehicle occupancy were losing ground, ridesharing was still able to make a significant contribution to the solution of small-scale problems. Carpools and vanpools provide economical transportation for large numbers of individual commuters, and employer-based ridesharing programs have made a measurable contribution to congestion relief in urban and suburban employment centers. Large employers who have provided their employees with intensive and personalized commute assistance report a significant increase in the use of collective transportation. It is to be hoped that the emergence of multiemployer transportation management associations will provide the organizational infrastructure necessary for ridesharing to make a similar contribution at the corridor scale.

But the future contribution of plural transportation to metropolitan mobility at large will depend on the relative strength of countervailing forces. Continuing deconcentration of the metropolitan population will diminish both plural and mass transportation's contribution to urban mobility. A concerted effort to manage traffic *and contain urban growth* would enhance collective transportation's contribution to urban mobility. In turn, land-use trends and land-use policy will determine the extent to which plural transportation can contribute—over the long term—to energy conservation, air quality improvement, and other large social purposes.

In the 1970s and 1980s, policy makers asked plural transportation to solve problems that are, in fact, deeply embedded in the land-use patterns and disorderly development processes characteristic of metropolitan America. These problems must be confronted directly—with policies designed to manage and contain urban growth. Then plural transportation can make a lasting contribution to urban mobility, environmental quality, and energy security.

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1 Dieter Klinger and J. Richard Kuzmyak, *Personal Travel in the United States; Yol. I and II, Nationwide Personal Transportation Study,* prepared by COMSIS Corporation for the FHWA (Washington, D.C.: U.S. Department of Transportation, August 1986), p. 6-13.

2 Ibid., p. E-117.
Each of these examples is drawn from programs that are operational. In some cases, elements from two or more programs are described as if they were part and parcel of one program.

4 Such programs operate at Bishop Ranch in San Ramon. California, and Lawrence Livermore Laboratories, Livermore, California.

5 The referent here is San Francisco's RIDES for Bay Area Commuters.

6 So-called user-side subsidy programs operate in 12 cities of Alameda County, California, including Oakland, Berkeley, Hayward, and Fremont.

7 An aggressive plan for coordinating HOV-lane development with employer-based ride marketing has been adopted in Santa Clara County, California.

8 KLINGER, *Personal Travel, pp.* 7-9 and 8-4.

9 U.S. DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS, *Statistical Abstract of the United States,* and*State and Metropolitan Area Data Book* (Washington, D.C.: U.S. Government Printing Office, 1989).

10WILLIAM O'HARE AND MILTON MORRIS, *Demographic Change and Recent Worktrip Travel Trends,* prepared by the Joint Center for Political Studies for UMTA, Technical Assistance Program, Report no. UMTA-DC-09-7009 (Washington, D.C.: U.S. Department of Transportation, February 1985), Tables M-70 and M-80.

11 KLINGER, *Personal Travel, p.* 4-19.

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EXERCISES

7-1 What are realistic expectations for ridesharing and paratransit programs?

7-2 Develop a taxonomy for classifying commute trips that are most and least likely to be made by carpool (as opposed to mass transit or by automobile alone).

7-3 Conduct interviews in your community to determine the extent to which local employers are involved in congestion management programs. If employers are actively involved, is that involvement reluctant or energetic?

7-4 Develop an implementation plan for a transit system that provides fixed-route service during the peak period and on-demand service during the off-peak. What operating policies would be needed to implement the plan?

7-5 Select a metropolitan area and investigate the trend of trip making in the region you have selected. Using market share as your primary indicator, examine whether ridesharing and transit use increasing or decreasing. What variables explain the trend in your area?